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Consultation on the Food-Processing Industry
with Emphasis on Fruit and Vegetable Processing

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FRUIT AND VEGETABLE PROCESSING IN CHINA*

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* The views expressed by the author in this document do not necessarily reflect those of the UNIDO Secretariat. This document has not been edited.

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I. SURVEY

1. The processing of fruits and vegetables by drying, pickling, salting and fermenting was initiated hundreds of years ago in China. However, modern techniques of processing by canning, concentration and freezing have been established for several decades. China exported 6,900 tons of canned vegetables in 1957 and 242,446 tons in 1984. Among those exports, that of canned mushrooms increased significantly, and with 110,000 tons was first in the world market in 1984. Factories for freezing fruits and vegetables were built in the mid-1960's. In 1987 production was approximately 20,000 tons, 50% of which was exported and the rest used for the domestic market.

2. In order to meet the demands of both the domestic and export markets, the processing of fruits and vegetables is encouraged by the Government. The processing industry is also considered an efficient way to increase the income of the rural people. The fruit and vegetables processing industry, which is spread out all over China, is administered by four institutions: the Ministry of Light Industry, the Ministry of Commerce, the Ministry of Foreign Economic Relations and Trade and the Ministry of Agriculture. The township industrial enterprises have developed tremendously through the rural economic reform. The total output value of the township enterprises has reached 273.2 billion yuan, which makes up 17% of the national total output value. Fruit and vegetables processing is one of the vital industries in these areas.

3. The total production of fruit in 1986 was 13.5 million tons (m.t.) and includes 3.34 m.t. apples, 2.55 m.t. citrus fruit, 1.25 m.t. bananas and 2.35 m.t. pears, 0.44 m.t. grapes. The total amount of vegetable marketing per year is approximately 1.5 m.t., excluding rural consumption. The above figures indicate great potential for the development of the fruit and vegetables processing industry.

Canning

4. There are approximately 600 canning plants which are under control of the Ministry of Light Industry. Total canned products in 1986 amounted to 1.64 m.t. of which 0.76 m.t. was fruit and 0.41 m.t. was vegetables. The amount consisted of 71.6% of the total canning production. Export of canned fruit was 0.05 m.t. and canned vegetables wes 0.28 m.t. totalling 75.3% of canned exports, earning $9.50 billion.

5. Most of the fruit is canned in syrup and the vegetables in spicy water. The production of juices is increasing. Among the canned fruits and vegetables, mushrooms are 0.11 m.t., followed by citrus fruits, pineapples, asparagus, water chestnuts, green beans, peas, bamboo sprouts, tomatoes, broad beans, apples, pears and peaches. The production of canned mushrooms doubled between 1980 and 1985, and asparagus has shown a big potential to increase. Seventy percent of the canning plants are located in provinces along the coast, such as Zhejiang, Fujiang, Guangxi, Shendong and Jiangxi, excluding the Sichuan province. Among them, Guangxi has shown the fastest development in recent years. In the 1950's, canned products were exported mainly to the Union of Soviet Socialist Republics and Eastern European countries and in the 1960's the trend was towards North America, West Europe and Japan. Since 1983 the consumption of canned products by the domestic market has exceeded exports and in 1985 reached 75% of total production.

Dehydration

6. The dehydration of Chinese date-jujube, slices of bamboo sprout, yellow day lily and mushrooms are traditional Chinese products. Most of them are exported and rank first on the world market. The exportation of the dehydrated Chinese date is 0.2-0.4 m.t. per year, the black jelly fungi (Auricularia) is 0.25 m.t. per year, which comprised 70% of the world production. The production of oyster cap fungus (Pleurotus ostreatus) is 0.02-0.03 m.t. The production of smoked pasania fungus (Lentinus edodes) is 2,000-2,500 tons, and white jelly fungi (Tremella fuciformis) is 1,500 tons.

There are more than 50 species of mushrooms cultivated in China, the production is 0.25 m.t. each year, which comprises 20% of the world production. The export of the dehydrated products in 1986 was as follows: yellow day lily 2,000 tons, smoked pasanin fungus 1,100 tons, black jelly fungi 1,300 tons and chili 31,000 tons.

Pickling and salting

7. Pickling and salting vegetables are also traditional processing methods in China. 0.32 m.t. of pickled and salted vegetables are produced annually by about 1,400 small enterprises. In 1985, production of the famous hot pickled mustard tuber - Tsatsai was 0.2 m.t. with exports of 12,000 tons. In addition, there are traditional candied fruit products of apricots, hawthorns, plums, prunes, apples, pears, tangerines, mangoes, etc. These products are exported mainly to South East Asia.

Freezing

8. The process of freezing vegetables for export was initiated in the mid-1960's and has steadily increased; in 1987 about 100 plants produced 20,000 tons. Half of the products were exported and the other half consumed on the domestic market. Products frozen are mainly peas, green beans, cauliflowers, sweet potatoes, eggplants, garlic stalks, cucumbers and sweet peppers. These products have become very popular on the domestic market in northern China, owing to the advantage of a low-temperature climate. Due to lack of cold chain facilities, the consumption of these products is limited in southern China.

9. In order to improve the quality of processed products, new techniques and facilities were introduced into China after the policy of opening to the world was adopted. For example, the automatically controlled tomato and jam producing and packaging lines, concentrated citrus and apple juice producing lines were bought from Sweden, those for asparagus from Spain and Japan, and those for tunnel fluidized freezers from Japan and the United States.

Improvements in the processing technology of the traditional dehydrated, pickled, salted and sugar-preserved products have also been carried out. For instance, a vacuum permeating new technique has been introduced which has shortened the production period of pickled cucumbers from 2 months to approximately 5 days. A decrease in the amount of salt as well as a lighter colour of the vegetables has also taken place to meet nutritional and health requirements. Comprehensive utilization of wild resources which are high in nutritional value has also been developed and increased.

II. PROSPECTS

10. Agro-industrial research co-operation on adaptable species for raw materials of processing has been conducted since 1965, mainly on citrus fruits, peaches, tomatoes, mushrooms and asparagus. Several cultivars have been selected and identified, and produced commercially in recent years. However, further improvements such as introduction of new varieties for processing, establishment and development of proper management, infrastructure, and processing of new materials are urgently needed to meet the demands of the world market and domestic requirements. Further efforts should be made to improve and resolve problems of firmness, lycopene content of tomatoes; fruit shape, and colour, thickness of flesh, even maturity of yellow peaches; red core of water chestnuts, seed production of asparagus, and rejuvenation and extension of high quality mushroom isolates.

11. Modern efficient energy-saving and low-cost facilities are needed to improve the quality of processing products. For example, facilities for automatic control of tomato pulp density are needed. Various facilities have been imported in recent years, yet the problem of how to make full use of these high-capacity facilities remains. Efforts should be made to establish high-efficient, low-cost and energy-saving facilities on a proper scale.

Consideration should be given to both the development of large-scale state enterprises and small-scale urban enterprises. The former possessing modern facilities and superior technology, are facing inadequate raw material supply and high cost of raw materials, while the latter producing and possessing low-cost raw materials, are short of proper facilities and technologies. Thus low quality products are being produced, which are below standard, even for the domestic market. However, some of the products exported are spoiling the fame of Chinese products. The situation indicates that the establishment of strong and viable agro-industrial complexes might be a solution.

12. Efforts have been made to establish quality control of products, packaging, cans and even model of manufacturing cans. However, further improvements are still urgently needed. In order to prevent waste of capital and quality decline, the quality, nutrition and safety control need to be implemented in advance. Foreign capital (either private investment or joint ventures), modern technologies and facilities are welcomed and encouraged by the Chinese Government. Various laws and regulations have been issued in recent years for those purposes. Regarding the above-mentioned situation, the following items would need special consideration: the introduction of varieties adaptable for processing; establishment, development and management of raw material and infrastructure; the introduction of efficient, energy-saving facilities, packaging materials and technology that would suit the situation in China, for large-, medium- and small-scale enterprises; establishment of agro-industrial complexes; training programmes both for technicians and managers; and co-operation on research projects related to all aspects above.

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Discussion paper on Issue I

BASIC REQUIREMENTS FOR LONG-TERM VIABILITY OF THE FRUIT AND VEGETABLE PROCESSING INDUSTRY*

Prepared by the
UNIDO Secretariat

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I. Introduction

1. Although the current global food situation is much improved in comparison with the mid-1970's, the problem of food supply and security in developing countries continues to be a major concern to governments and international development agencies. Many developing countries continue to face immense problems in ensuring adequate supplies of food on a regular, year-to-year basis and the number of malnourished people has increased.

2. Reduction in the availability of fruits and vegetables which are important sources of minerals and vitamins aggravates the malnutrition* problem and negatively affects people's capacity to work, learn and effectively function in society.

3. Of the total world fruit crops, nearly 60 per cent come from subtropical and an additional 25 per cent from tropical zones. Citrus fruits are the most important species for the developing countries. They had a share of 50 per cent in the 1980 world crop, and this will probably be increased to 56 per cent in the 1990s. Some 95 per cent of tropical fruits are cultivated in developing countries.

4. Only 15-20 per cent of the fruit and vegetables from the developing countries are exported in preserved (processed) state, and juices represent 22-27 per cent of these exports. This amount is higher in Latin America, where the rate exceeds 30 per cent, 90 per cent of which is in the form of concentrated juices. In the last few years, the rate of processed produce has shown an increase owing to the increase of juice exports. The average rate of processing of genuine tropical fruits does not reach 5 per cent.

II. National Strategies and Policies. Integrated development objectives and instruments

5. Dilemmas always exist for developing countries in setting priorities (urban versus rural, exporting cash crops versus producing subsistence crops) although economists have rejected dichotomies such as agricultural versus industrial development and have continually emphasized the growing interdependence of these two sectors. One of the main characteristics of food processing industry consists in the fact that, through sound national strategies and policies, a balanced development can be achieved so that farmers and entrepreneurs, irrespective of whether they are small or big, have access to modern technology which will increase yield, productivity and

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* The term malnutrition is used to describe food intake that is quantitatively and/or qualitatively inadequate and which results in physical effects on the human body.

income. Public policy instruments such as agricultural taxation, investment in infrastructure including research, price, marketing and trade policies have, as basic condition, to be integrated in a coherent economic framework.

6. Although governments' target areas would be staple foods, the fruit and vegetable sector is bound to receive appreciable attention since in some countries certain fruits and vegetables may be considered as staples (banana, potatoes, cassavas) and since, in many cases, there is overproduction of seasonal fruit and vegetables which, if not processed, would go to waste. Besides, it is well appreciated that the development of the sector supplements the food supply, can give an important boost to rural development, and increase incomes and employment. The sector can be a foreign exchange earner through exports, or a foreign exchange saver through import substitution.

7. There are obviously many activities, which small- and medium-scale entrepreneurs, who constitute the majority in the sector and who include probably all the indigenous processors, cannot afford to finance. The degree and level of government involvement and financing in the above activities, are determinant pre-conditions for the development of the fruit and vegetable sector and for attracting local and foreign investments to the sector. Government promotional measures mainly concentrate on:

- ensuring an adequate supply of raw materials, of the right quality, at the right price and at the right time;

- creating facilities for the quick transfer of produce from farms to processing units to avoid post harvest losses;

- supporting processor to be able to accept all available farm produce and to obtain a fair return on their investments.

8. The most critical point that emerges is that the policies and strategies of the government concerned should be reoriented for building a strong and viable agro-industrial base, and to this end, there should be a commitment to provide necessary incentives and infrastructure which is most essential, for a dynamic private sector to flourish and to attract private foreign investment. The removal of restrictions and liberalization of policies will attract increased foreign investments, and inflow of modern technology, which will contribute to the solution of the problems currently faced by the developing countries in the region.

III. Rational integration between agriculture and industry

9. The interdependence between agriculture and food industry as well as between the food and non-food industry influence macro policy processes in both developing and developed countries. Agricultural products provide inputs for the processed food sector which, in its turn, generates output for the non-food sector whereas the non-food sector provides inputs for agriculture. The link between agriculture and industry stretches, therefore, to farm and non farm inputs, consumption goods and capital goods. Investigations of such interdependence are, thus, essential to understand important macro and micro-economic processes.

10. The linkages with raw material producers should be strengthened and supported through research work, quality control, contractual arrangements and pricing systems in the recognition that the management of raw material is critical to the viability and efficiency of the industry.

11. The concept of a fruits and vegetables integrated plant, combining into one system all the links of the production chain, offers opportunities for progress in the food supply system, especially in the developing countries. The idea is to join into one logical unit the industries producing inputs and providing services for agriculture; agricultural production itself; procurement, transportation, and storage of agricultural raw materials; and the agro-industries and fruit and vegetables processing industries.

12. The physical proximity of industry to the raw materials production areas is one of the pre-conditions for improving the productivity of food processing plants, in particular fruits and vegetables. As a matter of fact inadequate planning and availability of raw materials have been identified as major causes of low levels of performance.

13. By siting processing plants near to the sources of raw materials, a wider spread of industrial growth is achieved which covers rural regions as well. With its stimulating effects on agriculture, the fruits and vegetables industry would thus contribute to a balanced, meaningful and sustained growth. Basic processing activities taking place in rural areas minimize the cost of transportation of bulky products and maximize freshness.

14. The relationship between the agricultural producer and industry can be regulated and fostered through supply/purchase contracts as well as through a direct investment by the processing industry which, in this way, can better plan and orient quality and quantity of raw material for processing purpose.

15. The industry, contracting the agricultural producers, supplies them with seeds and other farm inputs, gives guidance from the planting to the harvesting period as well as on post-harvesting practices, transportation and storage.

16. Approximately 25% of the global food supply is lost through spoilage, pests and waste. In the fruit and vegetable sector the percentage lost is even higher since fruit and vegetable are seasonal and perishable commodities, consequently their prices fluctuate between the lowest during the glut period and the highest during off-season. Cold storage facility serves for short term preservation and that is insufficient for certain fruits and vegetables (potato and banana for example), which could not be adequately preserved through use of this facility. Perishable foodstuffs may be converted into stabilized products when stored for extended periods of time, by employing technologies such as canning, freezing, freeze-drying, dehydration, fermentation, irradiation, etc. The linkage with the processing industry will also provide an outlet for utilization of waste or appropriate waste disposal, when necessary.

17. Fruits and vegetables are particularly sensible to mechanical injury and microbial decay and genetical engineering is developing plant research to

preserve quality for a longer time and to cut losses during harvesting, processing, shipping and marketing.

18. In the meantime waste utilization, therefore additional food potential for feeding people or cattle or for export, can be integrated in the processing plant so as to make maximum use of fruits and vegetables as major sources of vitamins and minerals. Recycling of waste and mechanical recovery are quite efficient processes. By-products of fruits and vegetables such as pulpwash, citrus cells, peel oil, essence, are expanding their industrial processing and marketing within the same optic of loss reduction in terms of nutritional factors produced and not used.

IV. Efficiency, Productivity

19. The concept of productivity is certainly easier to conceive than to achieve since pursuing productivity is not a short-term goal. The reward, however, fully justifies the effort.

20. Technological innovation plays an important role in a deeply changing sector like the food processing sector for achieving more production, better quality and for providing the necessary flexibility to adjust to innovations also occurring in the packaging sector. Processing methods are complex, particularly since raw materials vary so much and develop very rapidly.

21. Once canned foods contained additives and preservatives. Today the heat sterilization of the canning process preserves food without additives or preservatives and the can protects its contents from contamination. Fruits and vegetables are picked up at the peak of ripeness and sealed into cans in about three hours. In recent years the frozen food industry has also developed greatly and it is said to challenge canning for many types of food.

22. Technologies for mobile units are also available taking into account the conditions in developing countries. The mobile units are carrying out heat treatment processing and packaging, requiring water, energy and waste disposal. Mobile technologies are applicable on small-scale basis reducing transport distances. They are adaptable to local conditions and resources.

23. Irradiation is not a new technology since it was first patented as a food preservation process in 1930. It certainly offers numerous benefits in inhibiting sprouting of vegetables, delaying ripening of fruits and vegetables, destroying insects and preserving a variety of foods for extended shelf life. Its commercial application is however limited, due to a number of factors such as governmental regulations, safety concerns, and consumer acceptance.

24. Freeze-drying is a food preservation process whose technology has been known for many years. Its application is now growing in the food industry but cost factors related to investment and to plant operation, including utilities costs, make this preservation process mainly suitable for high-value products.

25. Product quality has always been a key issue in the food industry. Yet, the philosopy behind product quality has changed in recent years. Traditionally, emphasis was placed on the final product, making inspection of finished goods very costly and not improving product quality. Quality

assurance and quality control today should rather be seen as day-to-day quality programmes at the plant level, built-in part of the whole technical process with the involvement and commitment of all concerned.

26. Besides, with the changing of processing and packaging methods, testing and quality control have to adjust rapidly to new products put into the market.

27. Food processors and packaging suppliers have to work closely together bearing in mind the consumer needs and expectations to solve a number of problems related to cost, transport, safety and waste of packaging materials in one word, performance requirements of packaging.

28. Modern packaging is characterized mainly by paper-based and plastic packaging materials, their combinations (laminates) and metal-based materials; however, successful efforts have been made to improve traditional glass packaging, for example by reducing wall thicknesses or by using plastic coating on bottles. Modern wooden packaging is mostly used for transporting smaller packages. There is a wide range of wooden packaging methods in many developing countries.

29. At the international level, the choice of the applied packaging materials, methods and technologies depends on the processed fruits and vegetables, the characteristics of the end-products and the effects of the preservation technologies.

30. In the developing countries, hygienic requirements of the market and the often adverse climatic, transport and storage conditions should be taken into account. Thus, the most appropriate packaging would be metal-based (steel-plate, aluminium, chromium-plated steel plate) products, various combined plastic-metal-paper laminates and glass packaging materials. For juices, plastic bottles have now come into general use (depending on the properties of the fruit and the carbon dioxide content of the juice) and various polyolephines (PE, PVC, PP, polyester-based) packaging materials can be used. It is expected that, owing to more intensive use of the aseptic technology, combined packaging materials are likely to come to the front.

31. A decisive factor in the production of materials currently in use and those under development is economic efficiency. In the case of tin-plate, this could be achieved by a further reduction in plate and tin thicknesses and more efficient lacquering methods, in the case of glass materials by volume reduction and in the case of combined materials by more intensive use of sterilized materials. Complex cost calculations must be carried out before a final decision is taken. In certain developed countries an economical comparison was made in 1983/84 of aseptic technologies using different packaging materials and methods. Liquid food products, including fruit juices, were examined. The evaluations covered the total costs of the distribution system, including production and consumption costs, under well-defined conditions (price, availability etc.). (The results of the evaluation could also pertain to other food products). The conclusions reached are shown in the following table.

Comparison of costs of glass, metal and laminated-paper packaging as a percentage of total costs

Cost item	Glass	Metal	Laminated Paper
Packaging			
Consumer	58-60	73	
Collective and transport	16	10	
Subtotal	74-76	83	70
Processing and filling	2.5-3.5	1.6	7.2
Storage of empties	0.8-1.3	0.3	1.1
Transport and storage	13.6-15.1	10.9	10.7
Handling	4.9-5.8	4.1	9.12

32. For processed fruits and vegetables, the trend is towards high-grade mechanization guaranteeing hygienic safety and longer shelf-life. On the other hand, packaging methods that preserve the original aroma and vitamin and ingredient content of products are being widely developed: for example, the application of additives to preserve freshness, together with a sterile technology in a vacuum or controlled microclimate provide a means of preservation without cooling.

33. Concern is being expressed in several countries over the biodegradability of packaging which constitute, in a country like USA, 150 million tons of garbage per year.

34. Manufacturers need to make products which result in waste of low quantity and toxicity. So far many creative market-oriented innovations have been presented by the packaging industry but only few in the area of environmental acceptable packaging. The efforts in this direction have been so far directed towards eliminating or reducing environmental ill rather than towards anticipating the recycling/disposal problems. In this area, government support to investments in recycling and waste plants through financial and tax incentives has an important role to play.

V. Manpower training at all levels, management and organization skills

35. Food processing is traditionally more art than technology in the rural areas of developing countries. But in order to make the best possible use of food resources, in terms of preventing losses and retaining nutritive value, the technology portion must increase.

36. Although at present the spread of new technologies and training still differs from country to country it is nevertheless likely that the challenge of technological change will cause the trends to converge. Not very many new occupations have been so far created by the utilization of the technologies, which are known today. Rather the contents of jobs are changing considerably

and there will be a change in the importance of individual tasks within job categories. The utilization of new technologies requires not only new technology-oriented knowledge. In view of the all-round structural changes that are affecting the economy and society, in which whole industries, regions and manpower risk being marginalized in the development process, a training policy is needed which incorporates further training of manpower.

37. Although training content has to be adapted to each country's agricultural, industrial socio-economic, food situation and although each training institute has to choose for itself what seems to be the most appropriate training methods, it remains true that some aspects of food industry training will be broadly similar in different countries.

38. Human resource development and training should however be concentrated on management operations, and on the personnel dealing with technological processes and development programmes. In this area it is recommended that operational manuals related to training and technological processes should be worked out and utilized at all levels covering specific elements of production.

39. The problems will also be approached by giving trainees access to existing national documents (statistics, industrial and agricultural surveys, final reports of industrial development projects and products marketing projects, pricing policy documents) the analysis of which will provide them with information to help them gain a better understanding of the country's agro-industry problems.

40. In many developing countries food technology is experiencing a vigorous development and governmental resources, among other, are making successful efforts to impart new skills through training in the various aspects of fruit and vegetables production, processing and distribution systems. Public sector training programmes conducted by research institutes and governmental agencies should be aimed at reaching the various levels of trade and industry: large, medium, small scale and cottage level and should provide training in various skills encompassed in these levels: traditional techniques, technical skills and academic or management know-how.

41. The combination of research and training services linked together offers the benefit that new knowledge is transferred to industry and other academic centres. The philosopy of combining research with training works well in responding to manpower and information needs of the food industry. Research and development institutes receive the support of industries in various ways. The mutually reinforcing nature of research and development relationship with industry, in both the public and private sector of food industry, is a means that, when achieved, can serve as an example in planning the development of training centres for teaching applied technology.

42. Research and development institutes can organize short-term refresher courses for industry personnel in order to make available new knowledge and research results for industrial use. They also provide consultancy services to solve problems which require theoretical expertise. This role is particularly valuable when fruits and vegetable processing industry do not conduct extensive research and development activity.

43. One example could be the selection of equipment whereby the R and D institute is able to design or adapt machinery for specific uses which then obviate the need to import foreign technology. Both the consultancies and the short-term courses serve a trouble-shooting function of R and D for the public and private sectors of industry.

44. Industry can provide support for tuition costs for a proportion of trainees and also the opportunity of practical field experience after the coursework. Industry representatives may give lectures occasionally to enhance the regular training programme. Ultimately, all parties benefit, through the employment of graduates whose training has covered the technical subject more broadly and deeply than required.

VI. Markets

45. The number of people living in cities increased more than threefold from 600 million in 1950 to over 2.2 billion in 1988. By the year 2000 more than half of humanity will be city dwellers. The rapid urbanization of the world is among the major causes for steadily increasing marketing margins, i.e., the costs of getting food from producers to consumers. The farther consumers live from food production areas, the more important marketing becomes. This is because, and this applies both to domestic and export markets, the distance between food producers and consumers increases geographically, in form and in time.

46. In 1988 at least 800 million people were on diets that fell short of essential nutrients such as vitamins and minerals. Evidently the technology of marketing, which includes all functions performed in getting food from producers to consumers, has been neglected or given low priority. Prime concern is often the increase of production, agricultural and industrial. The price paid, however, for this neglect of marketing is very high: increasing food imports, large post-harvest losses, growing malnutrition. In spite of the increased agricultural and industrial food production occurred in the last 35 years or so, it turned out that even if there is enough food in the world it does not reach all those who need it.

47. The international market plays an important role in respect to the development of tropical fruit and vegetables production. The influence of imports should be limited to quantities but also take into consideration quality, prices and potentiality for further growth. The introduction of these products in sophisticated markets like the European countries and, to some extent, the United States and Japan was a long way and required a great deal of effort directed to the production of products in accordance with the market requirements in respect to acceptance of new flavours, in finding the proper way to promote the new products and make them pricely attractive.

48. There is evidence that the upwards trend of tropical fruits will continue, particularly now when there are signs of a new phase of economic growth in Europe after a period of recession. The main factors explaining the acceptance of exotic fruits both fresh and processed in the international market are:

- increased travelling and exposure to exotic flavours;
- increasing wealth and spending power;
- promotion;
- lower prices

49. The above factors influence both the fresh and processed items.

50. In respect to the processed products, the main factors influencing the increase in demand are:

- the use of new packaging, aseptic cartons (tetrapack);
- introduction of multi-fruit drinks

51. Processed tropical fruit and vegetables are becoming current components of the diet of a large number of industrialized countries. In addition to importing, several of these countries also produce or re-export products which are re-processed into their final consumption forms.

52. The market of pulps and paste which are processed into final products and re-exported makes it difficult to obtain statistical data of consumption in different countries which do not have a statistical breakdown of all the processed fruit and vegetable products. It can be stated that in one way or the other the tropical products under study have internationally been incorporated into the eating habits.

53. The problem of marketing has a different aspect in developed countries where the food marketing is aimed at meeting consumer demands quickly and directly. Criteria such as flavour, health, variety, convenience, portion control and value are behind products success or failure.

54. Nutrition-related issues that are of most concern include vitamins, minerals and sugar. Considerations related to demographical and sociological factors such as changes in age of consumers, increase of women in the workforce, have a strong impact on food demand as well as new types of retail stores like hypermarkets and take-out shops.

55. New trends due to the advent of microwave or to preferences for health food by an increasing number of health-conscious consumers are altering traditional food marketing techniques. There is therefore a constant need to monitor consumer taste using all that technology can offer.

56. More and more market research, new product development, packaging and information technology will be required in view of the changes in the fruit and vegetable processing industry.

57. As far as the Single European Market of 1993 is concerned, an EEC research programme, FAST* II, studied changes in the food area because it was felt that new technologies, particularly biotechnologies, could revolutionize the food system in the coming years. Besides, the food system in Europe involves 320 million consumers and employs 20 per cent of the EEC workforce

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*Forecasting and Assessment in Science and Technology.

(farmers, food processors, catering and distribution employees), playing therefore a vital role in European life. Emphasis according to FAST II will be more and more on quality, diversity and healthy products. Labelling will focus attention on components of food and there will be a decline in the use of synthetic colours and flavours. The use of natural materials is forecast to rise. An extensive research programme, the Food Linked Agro-Industrial Research (FLAIR) will promote research into the assessment and enhancement of food quality, food hygiene, safety and toxicology.

58. The ability by developing countries of exploiting newly emerging market niches for fruit and vegetable products has therefore to be fostered as well as promotion and market intelligence.

VII. Final Considerations

59. In the light of the above appreciation of the status and problems of the fruit and vegetable processing in the developing countries in the context of domestic and international supply/demand perspectives, the Consultation Meeting may wish to examine the following key considerations with a view to reaching conclusions and recommendations for enhancing the development of the sub-sector, namely,

(a) The economic and social importance of the sub-sector

(i) Contribution to food supply and security objectives: malnutrition - balanced diet

(ii) Employment creation in the rural areas: rural-urban balance

(iii) Efficient utilization of raw material resources: reduction of waste through processing, waste utilization, by-products

(iv) Contributions to foreign exchange earning/savings - objectives

(v) Linkage and spread effect benefits as part of agro-industrial systems and integrated rural development

(vi) Growth opportunities for small and medium enterprises in the sub-sector as well as in related manufacturing inputs production and service activities which its expansion would generate

(b) Supply/demand prospects of the sub-sector

(i) Production for domestic demand: promotional measures, nutritional problems, dietary habits

(ii) Production for exports (interregional and international markets)

(iii) Global institutional, legal and trading arrangements affecting the future export potentials of the developing countries

(c) Policy and institutional pre-requisites for the development of the sub-sector

(i) Strategic planning and policy formulation to integrate the fruit and vegetable processing sub-sector in the agro-industrial system, rural development programmes, agriculture and industrial policies and programmes:

-new productive capacities
-industrial rehabilitation and restructuring

(ii) Public sector policy and incentive measure to create the environment for increased private (domestic and foreign) sector investments:

-Reorientation of industrial policies focussing on integrated agro-industrial development in which the fruit and vegetable sub-sector would play its assigned role in economic and social development and which at the same time would serve as a framework for inducing investments;

-Development of institutional capabilities for export and investment promotion, research and development, standardization and quality control, training;

-Establishment, administration and harmonization of an effective incentive system.

(iii) Policies and programmes for the mobilization of financial resources:

-Capabilities for the identification and preparation of investment projects and for consultancy engineering services;

-Entrepreneurship development;

-Domestic and international sources of financing: priorities and requirements.

(d) Prerequisites for operational efficiency and productivity

(i) Technology options and choices

-Spectrum of technologies: drying, canning, quick-freezing, freeze-drying, aseptic techniques

-Alternative technologies and choices

-The role of R+D institutions

-Production process and quality control

(ii) Packaging

-materials and costs
-design of packaging alternatives
-consumer preferences
-domestic and export market requirements
-packaging machinery

(iii) Skills development

-technological, plant level, managerial and organizational
-institutional programmes for development of skills

(iv) Administration and organization efficiency

-coordination of public programmes: national, zonal and community
-delivery of information and promotional services to investors
-inter-sectoral and inter-industry linkages

(v) Raw-materials supply

-contractual arrangements between agricultural producers and purchasers;

-quality up-grading through better utilization of agricultural chemicals, mechanization and biotechnology innovations;

-expansion of rural transport equipment industries

-provision of storage facilities as well as repair and maintenance workshops.

(vi) Quality control and standardization

(e) Market and Marketing

(i) market development: national, regional and international

(ii) market information and intelligence systems:

-tropical products
-others
-market promotion skills

(iii) packaging pre-requisites

-quality control, standardization, possibility of recycling, consumer preferences

(iv) tariff and non-tariff barriers

(v) distribution channels

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I. Introduction

1. The status of the development of the fruit and vegetable industry widely varies among countries and regions. There are, however, common concerns and objectives, namely,

a) to derive added value from raw material resources

b) to increase market shares in both domestic and export markets

c) to foster the process of industrialization through integrated development of agro-industries

d) to strengthen the linkages between upward and downward allied industries (engineering, chemical, energy, small-scale industries)

e) to reduce losses and waste.

2. The industry itself is characterized by a variety of different factors. The first factor is raw materials, depending on the natural endowments of producer countries - climate, soil, altitude, agricultural capabilities of producers, harvesting and storage methods.

3. The second factor is a great variety of forms and sizes of food and vegetable processing units, ranging from village industry type with simple equipment and few or no employees to large scale units with sophisticated and capital intensive equipment. The production of the sector has different forms depending on the degree of processing ranging from very simple treatment to more advanced and more complicated processing.

4. Another important factor is marketing. Marketing plans are formulated on the basis of analysis of market information.

5. All elements of marketing, such as product design, pricing, promotion, distribution should be integrated in a comprehensive strategy that will set up optimal balance between local and export market demands.

6. The fruit and vegetables industry can only function economically with the creation of an effective and viable linkage between agricultural producers and the processing industry. This provides for vertical and horizontal integration of the fruit and vegetable processing industry. This could be well done by farmers producing the right varieties of products with appropriate quality for processing industry through contracts and delivering their products to adequately sited processing industry.

7. In view of multiple types of raw materials, levels of processing technologies utilized, sizes of processing units, degree of sophistication of markets there can therefore be no standard approach in dealing with the fruit and vegetables processing industry.

II. The role of international organizations

8. In such questions as perspectives, appropriate national policies, assistance of international organizations may help to clarify basic obstacles of the sector development, encourage growth of the sector and contribute to ensure adequate raw material supply, profitable processing activities, successful market operations and proper financing arrangements.

9. The international organizations such as United Nations Industrial Development Organization (UNIDO), Food and Agriculture Organization of the United Nations (FAO), United Nations Conference on Trade and Development (UNCTAD), the International Trade Centre (ITC) and others, can help the developing countries to achieve these objectives.

10. UNIDO through the activities of the System of Consultations contributes to the development of the sector by:

a) defining major issues and areas that represent constraints to the industrial development process in developing countries

b) formulating and co-ordinating policies to overcome those constraints

c) identifying opportunities for investment promotion, technology transfer and development and technical assistance programmes through effective international industrial co-operation

d) initiating and promoting action-oriented programmes and projects for implementation in selected industrial sectors

e) providing developing countries with guidelines on the development of specific sectors.

11. FAO monitors the world food and agriculture situation, collects, analyzes and disseminates information in this field, pursues a food policy and conducts studies, mobilizes investment and financial aid for the developing countries.

12. UNCTAD is a principal instrument of the UN General Assembly for deliberation and negotiation in the field of international trade and related issues of international economic co-operation.

13. ITC carried out different projects in the areas of trade information, product and market development and export development of commodities in all developing regions.

14. Many of the developing countries depend on exports of processed fruits and vegetables to finance the imports necessary for their development and functioning of their economies. International organizations such as UNCTAD and FAO made efforts to help the developing countries to improve their trading position. Development of South-South trade can make an important contribution. The main obstacles to increasing export earnings seem to be limited access to export markets, owing to protectionism of industrialized countries and instability of prices.

15. Improvement of the scientific and technological capacities of the developing countries is essential for their sustained and accelerated development. International organizations (UNIDO, FAO, ITC) focus their research support activities on strengthening national research capabilities and also on fostering research collaboration at the regional, interregional and global levels. These research activities are mainly aimed at increasing production of fruit and vegetable processing industry, introduction of new technologies, problems of quality of raw materials supply.

16. Another international organization at the regional level, the Economic and Social Commission for Asia and the Pacific (ESCAP) has done considerable work in the field of production, processing and marketing of agricultural commodities e.g. coconut, pepper, oilpalm, etc., with UNIDO technical support and co-operation. At the subregional level, the Association of South-East Asian Nations (ASEAN) has implemented a number of sub-regional projects particularly in the food processing industry, which includes processing of fruits and vegetables.

17. In general, active and productive participation of such international bodies as FAO, UNIDO, UNCTAD, ITC, and UN Economic Commissions could help the developing countries to solve their basic problems in the development of this sector, for example, mobilization of financial resources, productivity, improvements of the fruit and vegetable processing, transfer of appropriate technology, data base on markets and exchange of information.

III. Financing

18. The governments of the developing countries could play a key role in encouraging the development of the agro-industrial sector through consistent policy and rational planning and increased linkages with the industrial sector. Development of the sector could generate employment opportunities, foreign exchange earning through increased exports and strengthen the industrial base.

19. Successful mobilization of the sector for real social and economic growth requires the formulation of a programme for an integrated supply system that provides for production, processing and marketing as interdependent functions. In this case government policies and budgetary allocation must be made for:

-increasing productivity and quality of production

-installation and extension of infrastructural facilities -storage, roads, transport, supply of water, electricity, communication services, etc.

-supply of agricultural inputs -fertilizers, pesticides, tools, agro-machinery

-promotion of investments through the grant of financial and fiscal assistance to primary and secondary producers

-setting up or strengthening of institutional support organizations for distribution of agricultural inputs, marketing of off-farms produce,

extraction services, provision of finance, creation of co-operatives and export marketing.

20. Financial aspects are connected with the procurement of adequate and permanent supplies of raw material and other inputs. Efforts should be made to extend the harvest period e.g. by using planting methods that utilize different seeds to obtain early or late crops or by irrigation, glasshouses, hydroponics which may make it possible to obtain more than one crop per season. In any case, an appropriate time picking, improvement of perishability aspect of raw materials, proper handling and storage is certainly one essential way to extend the season for the supply of raw materials.

21. In many developing countries, governments or national financial institutions have established a system of agricultural credit which meets the requirements of farmers. The pricing of raw materials is a crucial financial issue for processors in an industry where the material content might, in some cases, reach up to 70 per cent or more of the cost of production. Prices tend to vary greatly during one year or over several years, thereby causing uncertainty in financial planning.

22. One method of stabilizing the cost of raw materials is through purchase contracts with producers. This would not only provide a "long-term" price, but would also ensure the supply. Prices may be fixed on a cost-plus basis, namely a cost to farmers plus a profit margin or a base price which may be paid plus a bonus derived from the final prices obtained for fished goods. Many processors endeavour to add strength to the contractors by providing credits, agricultural inputs, technical assistance e.g. to improve the yield, thus making it more beneficial to both sides.

23. In contracts with farmers, processors may negotiate terms of payment for raw materials, where payment for produce would be made over an extended period. In this way, payment by processor to producer may be staggered in him with receipts from sale.

24. Another way is for processors to make use of forward contracts where the factory's expected output would be sold in advance at a fixed price expected to cover costs and preserve a margin of profit. In this case, the risk on end-market price is carried rather by the buyer than by the processor. Besides, such contracts may be accepted by banks as back-to-back security to provide commensurate overdraft credit facilities.

25. However, development of industry requires large amounts of capital and the improvement of infrastructure, but, in many cases developing countries are not able to mobilize the necessary funds internally; that is why the increased and effective flow of aid from the international community would remain vitally important.

26. Before investments are planned for the establishment of new industrial plants, a programme of rehabilitation and restructuring of existing industrial capacity should be undertaken for which assistance from international, financial and technical institutions could be sought.

27. Mobilization of financial resources should be undertaken on a broad scale particularly provision of equity and concessionary loans. Wider information on financing possibilities offered by financing institutions as well as donor countries in terms of a) joint ventures, b) different kinds of loans, c) barter agreements, d) donations, should be provided. In this connection the investment promotion activities should be tailored to the specific needs of the fruit and vegetables industry.

28. With regard to joint venture, the foreign partner would provide the necessary technology, equipment, management, technical support and access to market. In general, the fruit and vegetable processing industry is one of the least developed industries in many countries, and a set of urgent financial and economic measures are needed to improve its future prospects through international co-operation aimed at facilitating access to financial resources.

IV. Technology

29. Crucial factors in the development of the processing of fruit and vegetables are adequate processing technology, acquisition of processing know-how, machinery and equipment, packaging, etc. Improved technology is the driving force behind the agricultural growth.

30. All these factors impede the development of this sector in developing countries. There is an urgent need for technologies for processing tropical fruits such as papaya, mango, passion fruit, etc. as well as sophisticated technologies used in developed countries to give to processed fruits more and more a "fresh look" and taste. Success and efficiency of the sector production depends on the choice of the most suitable technology, review of alternative technologies which can include canning, freezing, bottling, dehydration, preserving, pickling, extraction, frying, toasting, fermentation and irradiation, as well as packaging.

31. In general the fruit and vegetable processing industries in the developing countries need rehabilitation and reorganization of technologies in order to make them efficient and competitive.

32. The unavailability and high costs of appropriate packaging affect the total price of the product up to 40-50 per cent. Special efforts should be undertaken to reach availability of low-cost local packaging materials, packaging equipment, and design.

33. These measures will raise the competitiveness of a country's fruit and vegetable processing industry. Efforts should also be concentrated on strengthening existing regional technology centres, which could provide countries in different regions with information, consultation and legal advice in all technology related fields in the framework of South-South co-operation. An important task for the future will be to develop, using both traditional and new research techniques, technologies that can help developing countries satisfy their production needs.

34. In this case there is a need to broaden North-South co-operation so as to cover transfer of technology, investment in agricultural production, opportunity studies identifying the most suitable type of agricultural production.

35. Utilization of domestic materials and resources could reduce cost of packaging for developing countries. Many countries also encourage, through incentives for research and development, the substitution of domestic raw materials for costly imports; with assistance of such international organizations as UNCTAD, UNIDO, FAO, the International Trade Center and others developing countries can select indispensable domestic materials for packaging and appropriate technology.

36. With regard to packaging requirements, conditions vary considerably from country to country, even within the European Community. Most European countries have numerous laws and degrees that regulate packaging and labeling. There are still many problems of comprehensive harmonization of legislations in this field which should be considered before the European Common Market is formed on 1 January 1993.

37. The situation in the field of packaging requirements is similar in most industrialized countries, raising explicit difficulties for exporting countries.

V. Equipment

38. Essential conditions for reaching and keeping the planned productivity level are appropriate and modern equipment, maintenance of industrial parts and availability of spare parts.

39. Cost of equipment is high to developing countries, especially in terms of spare parts, maintenance service, etc. Equipment, machinery and spare parts are imported from developed countries and often the imported technologies are not suitable and appropriate for the existing socio-economic conditions. Moreover, various imported equipment and machineries utilized for processing are of different types, capacity and efficiency. Another sensitive area is maintenance service and spare parts supply.

40. As far as equipment is concerned, closer contacts should be established and maintained between technology, engineering and equipment suppliers and users in the entire range of contractual operations, i.e. from the selection of equipment to the supply of spare parts and assurance of post-sale services; besides, local design and production of equipment and spare parts in developing countries should be fostered through regional co-operation and through the setting-up of small-scale workshops at country levels.

41. Special attention should be given in short term to strengthening or establishing national, regional repair and maintenance workshops and service network and upgrading capabilities of local technicians.

VI. Questions Related to Market

42. Market evaluation and promotion for fruit and vegetable production are of crucial importance for local consumption and international trade. Access to and better exchange of the market information is of crucial need for the development of this sector. An inadequate market analysis frequently leads to failure of firm's plans and projects. Recognition of a market opportunity and application of an appropriate technology are the important factors here.

The assessment of demand for processed fruits and vegetable producers by local consumption has to be balanced with the assessment of external demand. Local consumption requires information about potential changes in consumer demand.

43. Assessment of the market position of medium and small farmers in the developing countries suggested that one of the most favourable is that of participant in a production/marketing contract system for a particular crop organized by an enterprise with assured market outlets for the crop after processing. A full set of services is received on credit. It is likely to be based on specific research and be backed by the direct provision of seeds, pesticides, fertilizer on credit, etc. Individual private marketing enterprises in the framework of local market have advantages in readiness of quick response to changing market situation, very low cost operations, high confidence and low risk during the market operations using family ties. Limitations of private trader structures are: constraints or access to financial sources, varying management capacity.

44. The marketing efficiency of a group of farmers is increased by joint use of transport and other facilities, raising bargain power in sales transaction, availability of local leadership and management. The main problem of participation of co-operatives in marketing are: optimization of marketing opportunities due to limited marketing expertise, quality management.

45. Agricultural marketing boards are autonomous in their day-to-day operations but directly responsive to government policy. They are convenient instruments for the allocation of public capital and implementation of government price policies. Advantage of a government marketing organization coincides in its its eligibility for external aid, because most of the agencies including the international financing organizations need official counterparts.

46. Transnational corporations have a range of advantages, such as, possibility to mobilize capital funds at the lowest cost, supply of applied technology, qualified management experience, experience in meeting quality standards which leads to successful export marketing, access to market.

47. Emphasis should be placed on the importance of reaching an optimal balance between local and export market demands. The international market plays an important role in the development of less known tropical fruits (mango, papaya, chirimoya, kiwi and the like) and vegetable production. Introduction of these products in sophisticated markets like the European countries, the United States, Japan requires a great deal of efforts to adapt production to the market requirements in respect to acceptance of new flavours, finding proper ways to promote new products and making them attractive in terms of price.

48. Tropical goods account for more than half of merchandise exports of developing countries, including many poorest countries according to UNCTAD.

49. Income of tropical producers was US$ 37 billion in 1985, about half of all farm and forestry exports and 8 per cent of their total merchandise sales.

50. As an illustration, Brazil's estimated production of orange juice concentrate alone is 600,000 tons per annum, of which 550,000 tons are exported, resulting in a foreign exchange earning of US$660 millions.

51. Other countries such as Philippines and Thailand export substantial quantities of canned pineapple valued at US$120 - 130 million and US$150 million respectively. The developed countries are the recipients of most of the export of processed fruits and vegetables from developing countries. New elements under discussions with the aim to improve process of international trade liberalization dealt with recently signed agreement between the European Community, the United States, Japan and others. Reduction of tariffs on tropical products can bring net benefits to the producing countries.

52. In this connection great efforts should be devoted to a comprehensive and thorough economic analysis of the market forces as well as the structural aspects of trade in processed fruits and vegetables in order to reach a better understanding of the present situation and perspectives. An analysis of the external factors should encompass the role of the UN system, international organizations such as UNIDO, FAO and ITC which could assist the developing countries in this field.

VII. Final Considerations

53. In light of the considerations outlined above, the Consultation Meeting may wish to examine the following proposals with a view to reach conclusions and formulate recommendations for promoting international co-operation to overcome the constraints faced by the developing countries in the development of the fruit and vegetable processing industry, namely:

(a) Technical co-operation

Orientation of bilateral and multilateral technical co-operation to give a sharper and increased focus on the fruit and vegetable processing industries and specifically in regard to:

--strategic planning of the sub-sector as an integral part of agro-industrial systems and rural development programmes;

--formulation and implementation of policy and incentive policy measures;

--rehabilitation and restructuring programmes and projects;

--capacity and capability development for planning and implementing new productive facilities particularly in regard to market development and market intelligence and investment promotion

with emphasis on main aspects such as:

--entrepreneurship development;

--productivity improvements;

--research and development, product design, adaptation;

--packaging;

--quality control and standardization;

--training;

(b) Technological co-operation

-choice, transfer and adaptation of technology;

-alternative technologies, flexible production processes and polyvalent plants;

-exchange of information and experiences among technology centres

-guideline/checklist for the purchase of technology/equipment and related services including production/supply of spare parts and provision of repair and maintenance services;

-twinning arrangements between R+D centres in industrialized and developing countries in regard to joint research work and exchange of information and experiences;

-consultancy engineering services;

(c) Financial co-operation

-Joint venture arrangements: equity, marketing and management services;

-Sub-sectoral financing needs and modalities for the mobilization of financial resources in light of the specific raw-material, working capital and operational requirements;

-Loans and credits from international and regional financial institutions on concessionary basis for the agro-industries sector and the fruit and vegetable processing sub-sector in particular in light of the food supply and security objectives of the developing countries;

-Capacity and capability development in the developing countries for the identification, formulation and implementation of investment projects;

-Investment promotion: institutions, programmes and projects;

-Linkage of financing of agricultural input industries, raw-material supply, processing, packaging and marketing of food-processing products.

(d) Market development and marketing

-Mechanisms and procedures for information gathering and analysis of the demand prospects of the industrialized countries for the producers of the developing countries;

-Policies and programmes which increase the share of the developing countries in export markets;

-Mechanisms and instruments that could be created to assist the developing countries plan their investment programmes in the sub-sector;

-Demand prerequisites that would determine the marketing strategies of the developing countries.

(e) Institutional framework and mechanisms for enhancing international co-operation

-Advisory committee of experts to monitor the implementation of the recommendations of the Consultation meeting;

-Regional network for promoting co-operation in investments, technical assistance and capacity building;

-Programme of regional and interregional co-operation in investments, technical assistance and capacity building;

-Network of financial and development banking institutions to co-ordinate their lending institutions in the fruit and vegetable processing sector;

-Tripartite co-operation whereby the technological potentials of the industrialized countries in centrally-planned and market economies could be utilized in conjunction with the financial resources of the developing countries and regional institutions to invest in new productive capacities and/or rehabilitating existing ones;

-Training of skills at all levels: planning, pre-investment and feasibility studies, investment and technology packaging, construction and start-up, operations, management and marketing and re-investment.